USB-1024HLS

High Drive, 24-bit Digital I/O
Low-speed USB 2.0 device

User's Guide

MEASUREMENT COMPUTING.

USB-1024HLS

USB-based Digital I/O Module

User's Guide

MEASUREMENT COMPUTING™

Document Revision 2, May, 2006
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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the USB-1024HLS so that you get the most out of its USB digital I/O features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal® installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

- MCC's *Specifications: USB-1024HLS* (the PDF version of the Electrical Specification Chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/USB-1024HLS.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

USB-1024HLS User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/USB-1024HLS.pdf.

Introducing the USB-1024HLS

This user's guide contains all of the information you need to connect the USB-1024HLS to your computer and to the signals you want to measure.

The USB-1024HLS is a USB 2.0 low-speed module supported under popular Microsoft® Windows® operating systems. It is designed for USB 1.1 ports, and was tested for full compatibility with both USB 1.1 and USB 2.0 ports.

Refer to the "Be sure you are using the latest system software" note in Chapter 2, "Installing the USB-1024HLS," to make sure you are using the latest USB drivers.

The USB-1024HLS is a high drive, 24-line digital I/O module that includes one 32-bit external event counter. The module is powered by the +5 volt USB supply from your computer. No external power is required.

An emulation of the 82C55 in mode 0 (only) sets the direction of the 24 digital I/O lines in four ports. Each digital port can be configured for either input or output. The 74FCT244 outputs are high-drive TTL, capable of sourcing 15 mA and sinking 64 mA.

The USB-1024HLS is shown in Figure 1-1. All I/O connections are made to the screw terminals on each side of the USB-1024HLS.

Figure 1-1. USB-1024HLS

USB-1024HLS block diagram

USB-1024HLS functions are illustrated in the block diagram shown here.

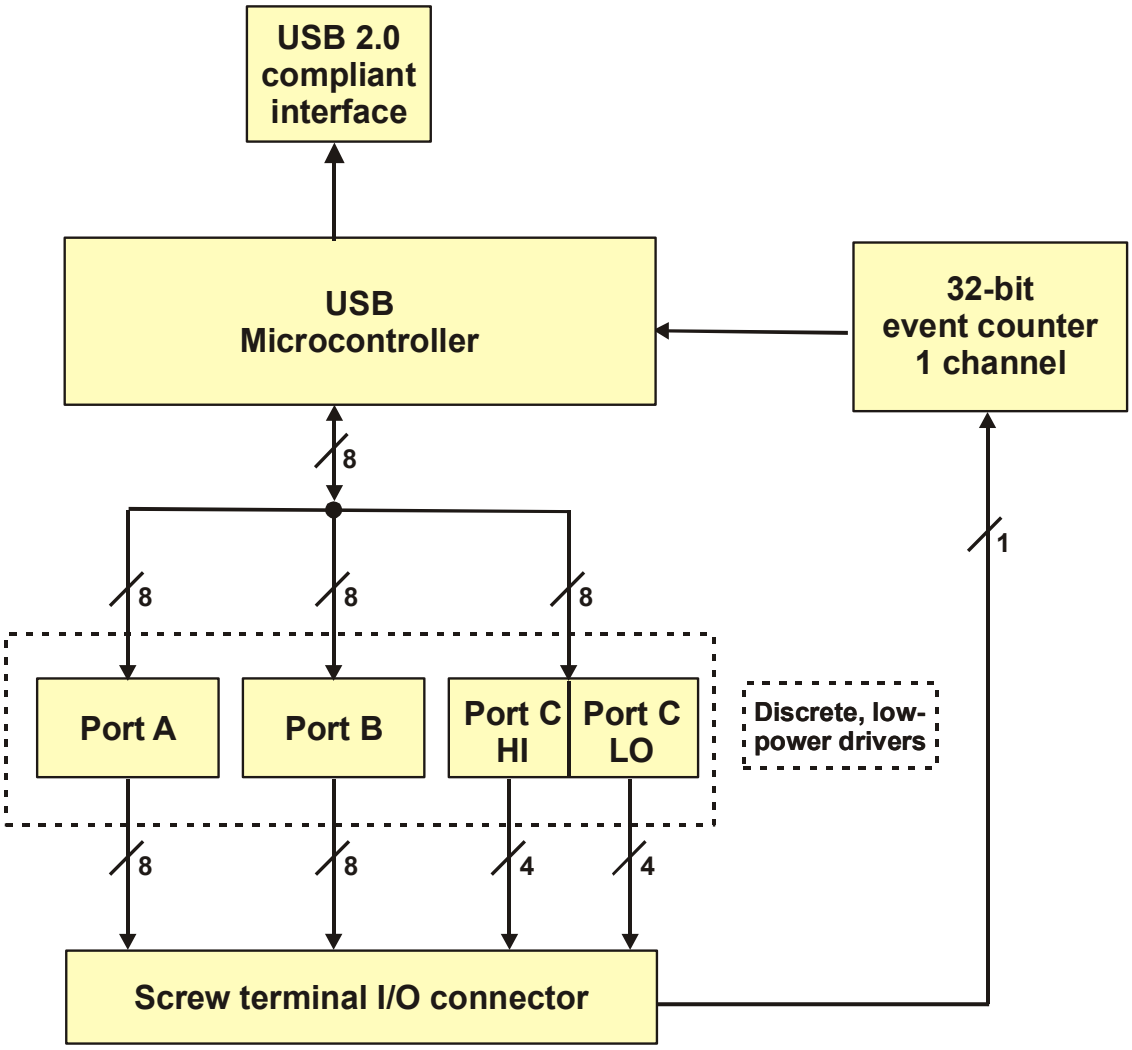


Figure 1-2. USB-1024HLS functional block diagram

Software features

For information on the features of *Insta*Cal and the other software included with your USB-1024HLS, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.

Connecting a USB-1024HLS to your computer is easy

Installing a data acquisition device has never been easier.

- The USB-1024HLS relies upon the Microsoft Human Interface Device (HID) class drivers. The HID class drivers ship with every copy of Windows that is designed to work with USB ports. We use the Microsoft HID because it is a standard, and its performance delivers full control and maximizes data transfer rates for your USB-1024HLS. No third-party device driver is required.
- The USB-1024HLS is plug-and-play. There are no jumpers to position, DIP switches to set, or interrupts to configure.
- You can connect the USB-1024HLS before or after you install the software, and without powering down your computer first. When you connect an HID to your system, your computer automatically detects it and configures the necessary software. You can connect and power multiple HID peripherals to your system using a USB hub.
- You can connect your system to various devices using a standard four-wire cable. The USB connector replaces the serial and parallel port connectors with one standardized plug and port combination.
- You do not need a separate power supply module. The USB automatically delivers the electrical power required by each peripheral connected to your system.
- Data can flow two ways between a computer and peripheral over USB connections.

Installing the USB-1024HLS

What comes with your USB-1024HLS shipment?

The following items are shipped with the USB-1024HLS.

Hardware

- USB-1024HLS

- USB cable (2 meter length)

Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-1024HLS and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the USB-1024HLS

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-1024HLS from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If your USB-1024HLS is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail. For international customers, contact your local distributor where you purchased the USB-DIO24/37.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the hardware

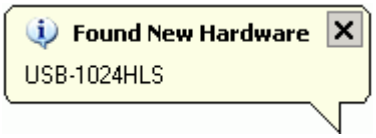
Be sure you are using the latest system software

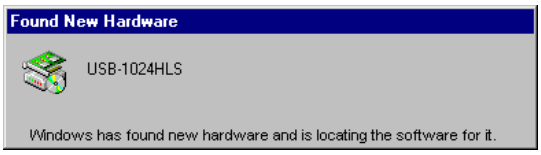
Before you connect the USB-1024HLS, make sure that you are using the latest versions of the USB drivers.

Before installing the USB-1024HLS, download and install the latest Microsoft Windows updates. In particular, when using Windows XP, make sure you have XP Hotfix KB822603 installed. This update is intended to address a serious error in Usbport.sys when you operate a USB device. You can run Windows Update or download the update from www.microsoft.com/downloads/details.aspx?familyid=733dd867-56a0-4956-b7fe-e85b688b7f86&displaylang=en. For more information, refer to the Microsoft Knowledge Base article "*Availability of the Windows XP SP1 USB 1.1 and 2.0 update.*" This article is available at support.microsoft.com/?kbid=822603.

To connect the USB-1024HLS to your system, turn your computer on, and connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The USB cable provides power and communication to the USB-1024HLS.

When you connect the USB-1024HLS for the first time, a **Found New Hardware** popup balloon (Windows XP) or dialog (other Windows versions) appear as the USB-1024HLS is detected.





Another **Found New Hardware** balloon or dialog opens that identifies the USB-1024HLS as a USB Human Interface Device.

When the balloon or dialog closes, the LED on the USB-1024HLS should flash and then remain lit. This indicates that communication is established between the USB-1024HLS and your computer

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-1024HLS, or you may lose data and/or your ability to communicate with the USB-1024HLS.

If the LED turns off

If the LED is lit but then turns off, the computer has lost communication with the USB-1024HLS. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should turn back *on*.

Functional Details

External components

The USB-1024HLS has the following external components, as shown in Figure 3-1.

- USB connector
- LED
- Screw terminal banks (2)

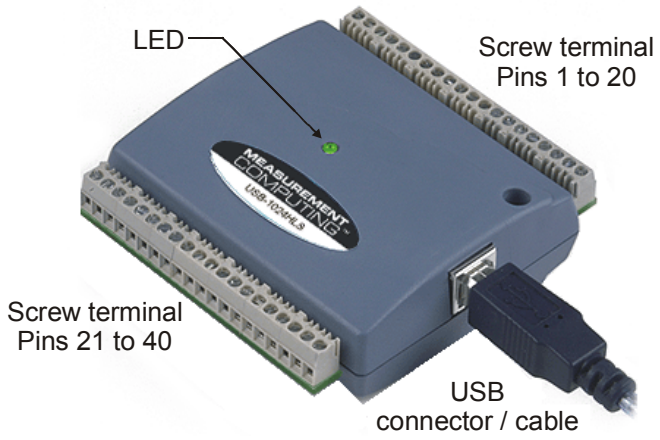


Figure 3-1. USB-1024HLS external components

USB connector

The USB connector is on the right side of the USB-1024HLS housing. This connector provides +5 V power and communication. The voltage output is system-dependent, and may be less than +5 V. No external power supply is required.

LED

The LED on the front of the housing indicates the communication status of the USB-1024HLS. It uses up to 5 mA of current and cannot be disabled. Table 3-1 explains the function of the USB-1024HLS LED.

Table 3-1 LED illumination

LED Illumination	Indication
Steady green	The USB-1024HLS is connected to a computer or external USB hub.
Blinks continuously	Data is being transferred.
Blinks three times	Initial communication is established between the USB-1024HLS and the computer.

Screw terminal wiring

The USB-1024HLS has two rows of screw terminals—one row on the top edge of the housing, and one row on the bottom edge. Each row has 20 connections. Pin numbers are identified here.

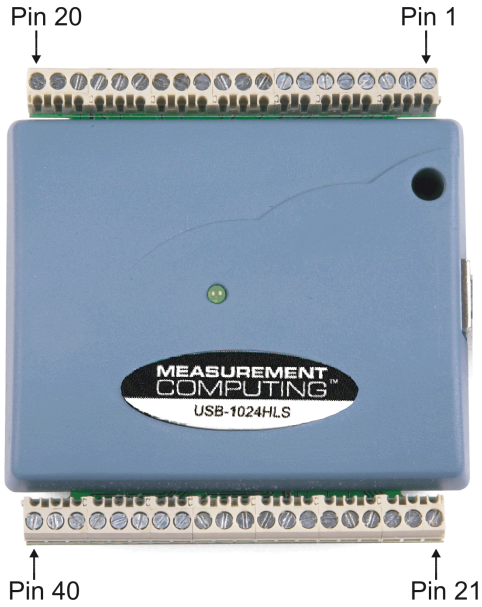


Figure 3-2. USB-1024HLS screw terminal pin numbers

Screw terminal – pins 1 to 20

The screw terminals on the top edge of the USB-1024HLS (pins 1 to 20) provide the following connections:

- Eight digital I/O connections (**Port C0** to **Port C7**)
- One counter connection (**CTR**)
- Two power connections (**USB +5 V**)
- Three pull-up and pull-down connections (**Port A Pull-up/Pull-down**, **Port B Pull-up/Pull-down** and **Port C Pull-up/Pull-down**)
- Six ground connections (**GND**)

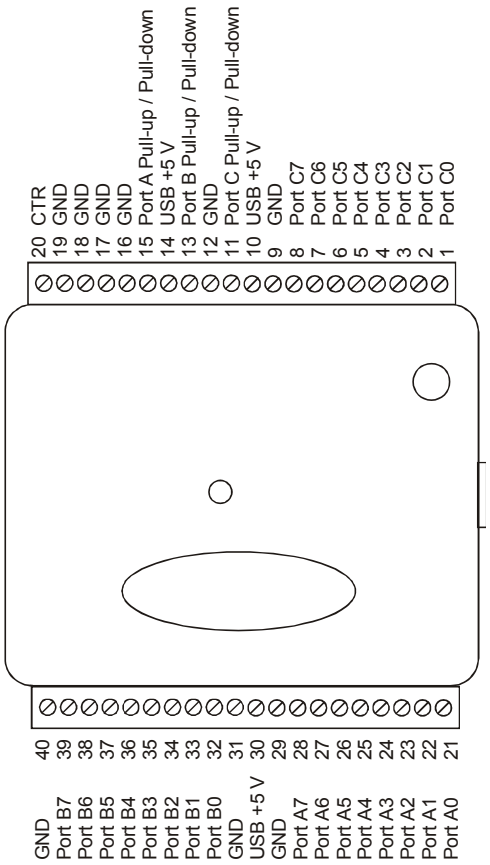
Screw terminal – pins 21 to 40

The screw terminals on the bottom edge of the USB-1024HLS (pins 21 to 40) provide the following connections:

- 16 digital I/O connections (**Port A0** to **Port A7**, and **Port B0** to **Port B7**)
- One power connection (**USB +5 V**)
- Three ground connections (**GND**)

Main connector and pin out

Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG



Digital I/O terminals (Port A0 to A7, Port B0 to B7, Port C0 to C7)

Connect up to 24 digital I/O lines to the screw terminal containing pins 1 to 8 (**Port C0** to **Port C7**), pins 21 to 28 (**Port A0** to **Port A7**), and pins 32 to 39 (**Port B0** to **Port B7**). Refer to the pinout diagram on page 3-2 for the location of these pins. You can configure each digital port for either input or output.

When configured for input, you can use the USB-1024HLS digital I/O terminals to detect the state of any TTL level input. Refer to the switch shown in Figure 3-3 and the schematic shown in Figure 3-4. If you set the switch to the +5 V input, Port A0 reads TRUE (1). If you move the switch to GND, Port A0 reads FALSE.

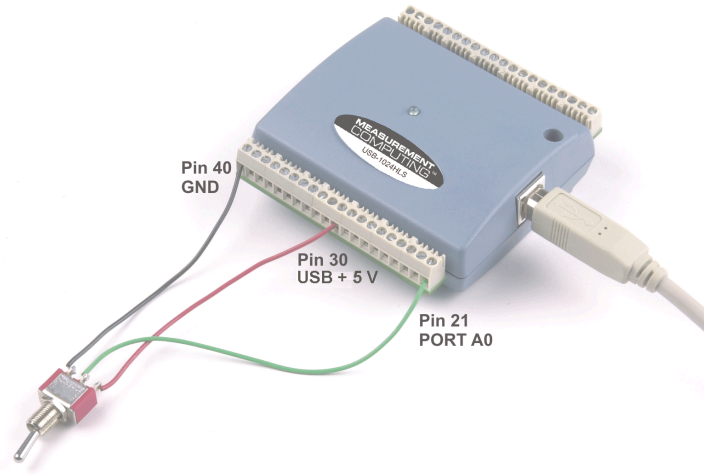


Figure 3-3. Digital connection of Port A0 detecting the state of a switch

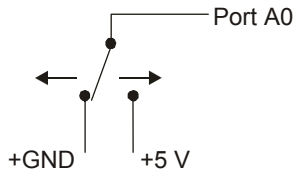


Figure 3-4. Schematic showing switch detection by digital channel Port A0

For more information on digital signal connections

For more information on digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at www.mccdaq.com/signals/signals.pdf).

Power terminals

The **USB +5V** connection (pin 30) is on the bottom screw terminal of the USB-1024HLS. Refer to the pinout diagram on page 3-2 for the location of this terminal. This terminal draws power from the USB connector. The +5 volt screw terminal is a +5 volt output that is supplied by the connected computer.

Caution! The USB +5 V terminal is an output. Do not connect to an external power supply or you may damage the USB-1024HLS and possibly the computer.

Once you start running applications with the USB-1024HLS, each DIO bit can draw up to 15 mA. The maximum amount of +5 V current available for external use, over and above that required by the USB-1024HLS, is the difference between the total current requirement of the USB-1024HLS (based on the application), and the allowed current draw of the computer platform.

The following power limits depend on whether you are sourcing current out of the USB-1024HLS, or you are sinking current into the USB-1024HLS.

Output (source) current limits: desktop computers and self-powered hubs

The maximum allowed current draw for a typical desktop computer and self-powered hub is 500 mA. You must account for the supply current drawn from the USB supply for the USB-1024HLS itself, plus the current used by each DIO line. Since each DIO line can output 15 mA maximum, 24 DIO × 15 mA = 360 mA (maximum rating for the chips).

Output (source) current limits: notebook computers and bus-powered hubs

The maximum allowed current draw for a typical notebook computer and bus-powered hub is 100 mA. Because the USB-1024HLS would use a significant portion of this available current, this leaves you with little or no current for the DIO lines. For this reason, the USB-1024HLS is not supported for this configuration. To overcome this limitation, an external self-powered hub can be used to supply the proper current level required for full output capability as noted above.

Output (sink) current limits

Each USB-1024HLS DIO output can sink up to 64 mA. For an individual line, this is not a problem. But if you were to apply this maximum load to all 24 DIO lines, you may damage the USB-1024HLS because the total amount of current is well over the maximum for the USB supply.

If you want to sink the maximum of 64 mA per DIO line, you can only do so with up to six lines. To sink current with all 24 DIO outputs at any one time, you can sink a maximum of 18 mA per line.

Ground terminals

The nine ground (**GND**) connections are identical, and provide a common ground for all USB-1024HLS functions. Refer to the pinout diagram on page 3-2 for the location of the **GND** terminal.

Counter terminal

Pin 20 (**CTR**) is the input to the 32-bit external event counter. Refer to the pinout diagram on page 3-2 for the location of this terminal. The internal counter increments when the TTL levels transition from low to high. The counter can count frequencies of up to 1 MHz.

Pull-up/pull-down terminals

You can wire pin 11 (**Port C Pull-up/Pull-down**), pin 13 (**Port B Pull-up/Pull-down**), and pin 15 (**Port A Pull-up/Pull-down**) to support a pull-up or pull-down connection. These terminals configure the internal 47K resistors on the USB-1024HLS. Refer to the pinout diagram on page 3-2 for the location of these terminals. These terminals are configured as open by default.

- To configure a pull-up connection for a specific port, wire the pull-up/pull-down terminal to a **USB +5 V** terminal.

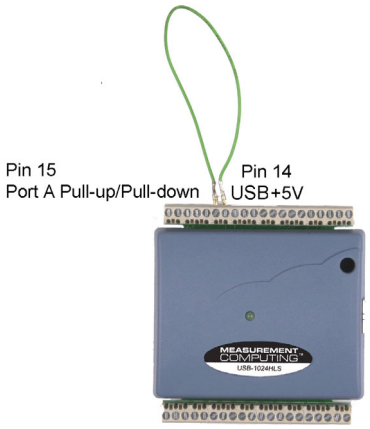


Figure 3-5. Pull-up connection for Port A

- To configure a pull-down connection for a specific port, wire the pull-up/pull-down terminal to a **GND** terminal.

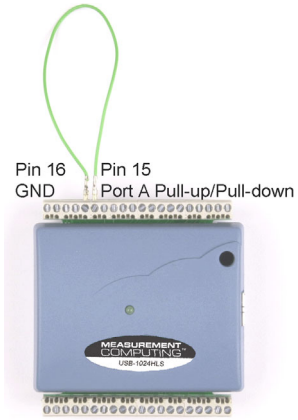


Figure 3-6. Pull-down connection for Port A

Wiring schematics are shown here for each pull-up/pull-down terminal. Dotted lines represent a pull-up or pull-down connection.

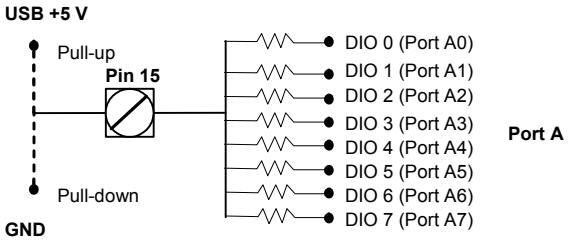


Figure 3-7. Schematic showing Port A pull-up/pull-down wiring options

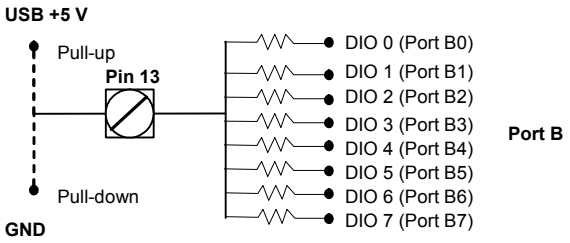


Figure 3-8. Schematic showing Port B pull-up/pull-down wiring options

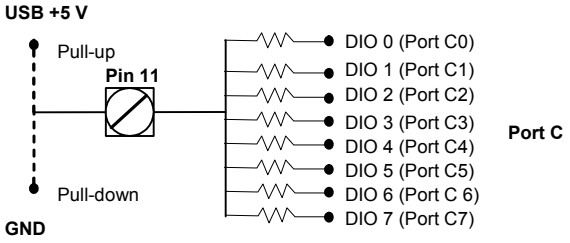


Figure 3-9. Schematic showing Port C pull-up/pull-down wiring options

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Digital input/output

Table 1. Digital I/O specifications

Digital input type	74ACT373
Digital output type	74FCT244
Number of I/O	24 (port A0 through port C7)
Configuration	2 banks of 8 and 2 banks of 4 or 3 banks of 8
Pull up/pull-down configuration	Internal 47K resistors may be user configured for pull-up or pull-down via external connection of "Port x Pull-up / Pull-down" to "USB +5 V" or “GND”. Ports A, B, and C are independently configurable.
Input high voltage	2.0 V min, 5.5 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output high voltage (IOH = -15 mA)	2.4 V min
Output low voltage (IOL= 64 mA)	0.55 V max
Source current – (Note 1) ▪ Self -powered hub ▪ Externally-powered root port hub	Maximum = 15 mA per output
Source current – (Note 2) ▪ Bus-powered hub ▪ Battery-powered root port hub.	Not supported
Sink current - (Note 3)	Current sink max: 365 mA / [number of outputs]. 64 mA max sink current for any single output.
Power up/reset state	Input mode (high impedance)

Note 1: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the PC’s USB Host Controller. The USB port(s) on your PC are root port hubs. All externally powered root port hubs (i.e. desktop PC’s) provide up to 500 mA of current for a USB device. In this configuration, all 24 digital outputs of the USB-1024HLS can source their per-pin maximum of 15 mA. This provides a total requirement of 15 mA*24 = 360 mA. Combining this with the USB-1024HLS operating current of 135 mA a fully-loaded current draw of 495 mA is realized.

Note 2: "Bus-powered hub" refers to a USB hub that derives power directly from the USB +5 V and does not have its own power supply. These hubs allow a connected USB device to draw up to 100 mA. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop is constrained to the 100 mA maximum a USB-1024HLS is not guaranteed to work. In order to use the product you will need to purchase a self-powered hub.

Note 3: A low-side resettable fuse protects the USB-1024HLS. This is designed to protect the host PC or hub from an over current condition. Assuming all return currents in sinking applications return via the USB cable ground signal, the maximum allowable return current is 500 mA. Please include the USB-1024HLS unloaded operating current (135 mA) in your power budget.

Counter section

Table 2. Counter specifications

Pin name (Note 4)	CTR
Counter type	Event counter
Number of channels	1
Input source	*CTR screw terminal*
Input type	TTL, rising edge triggered
Resolution	32 bits
Schmidt trigger hysteresis	*20 mV to 100 mV*
Input leakage current	*±1 µA*
Maximum input frequency	1 MHz
High pulse width	*500 ns min*
Low pulse width	*500 ns min*
Input low voltage	0 V min, 1.0 V max
Input high voltage	4.0 V min, 15.0 V max

Note 4: CTR is a Schmitt trigger input

Power

Table 3. Power specifications

Parameter	Conditions	Specification
Supply current (Note 5)	No load	80mA typ, 135 mA max
Input power requirements (Note 6)		4.75 V min, 5.25 V max
USB +5 V power available	Measured at "USB +5 V" screw terminals (pins 10, 14, and 30)	4.4 V min, 5.25 V max
USB +5 V power output current (Note 7)	Connected to: ▪ Self-powered hub ▪ Externally-powered root port hub	[350 mA] – [total output source current]
USB +5 V over-current protection	Resettable fuse	Hold current: 350 mA, typical
		Trip current: 700 mA typical
		Trip/recovery time: 100 mS, max
		On resistance: 1.3 Ohms max

Note 5: This is the total (no load) current requirement for the USB-1024HLS.

Note 6: Bus-powered hubs are allowed to provide downstream USB power as low as 4.4 V. Although your USB-1024HLS will typically function at this 4.4 V minimum, guaranteed performance requires a minimum power supply voltage of 4.75 V. All self-powered and root port hubs will meet this 4.75 V minimum.

Note 7: See available source/sink current level in the "Digital input/output" section.

General

Table 4. General specifications

Parameter	Conditions	Specification
USB controller clock Error	*25 °C*	*±30 ppm max*
	0 to 70 °C	*±50 ppm max*
Device type		USB 1.1 low-speed
Device compatibility		USB 1.1, USB 2.0

Environmental

Table 5. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 70 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 6. Mechanical specifications

Dimensions	79 mm (L) x 82 mm (W) x 25 mm (H)
USB cable length	*3 meters max*
USB cable type	*A-B cable, UL type AWM 2527 or equivalent.* *(min 24 AWG VBUS/GND, min 28 AWG D+/D-)*
User connection length	3 meters max

Main connector and pin out

Table 7. Connector specifications

Connector type	Screw terminal
Wire gauge range	30-16 AWG

Table 8. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	Port C0	21	Port A0
2	Port C1	22	Port A1
3	Port C2	23	Port A2
4	Port C3	24	Port A3
5	Port C4	25	Port A4
6	Port C5	26	Port A5
7	Port C6	27	Port A6
8	Port C7	28	Port A7
9	GND	29	GND
10	USB +5 V	30	USB +5 V
11	Port C Pull-up / Pull-down	31	GND
12	GND	32	Port B0
13	Port B Pull-up / Pull-down	33	Port B1
14	USB +5 V	34	Port B2
15	Port A Pull-up / Pull-down	35	Port B3
16	GND	36	Port B4
17	GND	37	Port B5
18	GND	38	Port B6
19	GND	39	Port B7
20	CTR	40	GND

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Measurement Computing Corporation declares under sole responsibility that the product

USB-1024HLS

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN 61326 (1997) Amendment 1 (1998)

Emissions: Group 1, Class A

- EN 55011 (1990)/CISPR 11: Radiated and Conducted emissions.

Immunity: EN61326, Annex A

- IEC 1000-4-2 (1995): Electrostatic Discharge immunity, Criteria C.
- IEC 1000-4-3 (1995): Radiated Electromagnetic Field immunity Criteria A.
- IEC 1000-4-8 (1994): Power Frequency Magnetic Field immunity Criteria A.

Power line and I/O tests to IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, and IEC 1000-4-11 were not required. The device is DC powered from an I/O cable which is less than three meters long.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in June, 2004. Test records are outlined in Chomerics Test Report #EMI3902.04.

We hereby declare that the equipment specified conforms to the above Directives and Standards.

Carl Haapaoja, Director of Quality Assurance

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